

CSC SUPPORTS GROUNDBREAKING SATELLITE MISSION

A small satellite built by college students with CSC's support carries big hopes for the use of nanotechnology in space.

CASE STUDY

Client:

U.S. Naval Academy

Challenge:

Work with the Naval Academy to design, build and launch a low-cost satellite that serves as a flexible platform for scientific experiments.

Solution:

Use off-the-shelf technology, a Linux-based operating system and communications based on Internet protocols to construct a no-frills satellite.

Results:

The MidSTAR-1 satellite has hosted several successful experiments, including the first application of nanotechnology in space.

For More Information:

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Following decades of work on major NASA efforts such as the Apollo program, we're playing a key role in the success of a small and relatively inexpensive next-generation satellite. With the help of CSC's aerospace expertise, students at the U.S. Naval Academy in Annapolis, Md., designed and built the MidSTAR-1 satellite from scratch. After a successful launch, the satellite has hosted a number of groundbreaking scientific experiments, including the first application of nanotechnology in space.

MidSTAR-1 is a relatively low-cost general-purpose orbiter powered by software that combines a Linux-based operating system with off-the-shelf technology. The open standards provide a flexible platform for conducting scientific experiments. The satellite took off from Cape Canaveral onboard an Atlas V rocket in March 2007 and is expected to remain in orbit indefinitely.

Building on experience

A team of CSC technologists with extensive NASA project experience worked closely with the Naval Academy to design a sophisticated communications system for the satellite. CSC was integral in designing and building the technical core of MidSTAR-1, including the hardware and software that serve as the central processors for the satellite's command and data handling. The CSC team, based at Goddard Space Flight Center in Greenbelt, Md., continues to help operate the spacecraft.

The success of the MidSTAR-1 mission is an outgrowth of more than a decade of work by CSC technologists who pioneered the concept that standard Internet protocols should serve as the basis for space communications. CSC's Keith Hogie, Ed Criscuolo and the late Ron Parise, a former astronaut who flew on two space shuttle missions, worked with the project team to write customized software, construct the flight computer and integrate the computer with the onboard communications system.

Next-generation satellite

Working with NASA, private companies and several universities, the CSC team is using a new approach to designing smaller and cheaper satellites. Hogie says, "The success of MidSTAR builds upon CSC's work on previous satellites and on the lessons learned flying a payload on the space shuttle in 2003. We learned a lot from our experience and it's why we were able to pull off MidSTAR."

The satellite's technical setup is remarkably simple. MidSTAR-1's Linux-based operating system communicates with a router on a ground station at the Naval Academy that picks up IP packets as if it were on a standard Internet-based network. Criscuolo says, "Because everything is based on these standards, we can remotely access the onboard system from virtually anywhere in the world. Plus, we can operate the ground station from anywhere we've got an Internet connection."

CASE STUDY

CSC SUPPORTS GROUNDBREAKING SATELLITE MISSION (CONT.)

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*Naval Academy
Professor and
MidSTAR-1 Program
Manager Billy Smith*

The simplicity of the standards-based design has also made the satellite a desirable platform for conducting space experiments. Jim Langston, a senior program manager at CSC, says, "The beauty of the setup is that we can upload a new set of software for any project that wants to experiment with something. Because it's all based on these standards, you can just upload their systems and their software, let them run their experiments and then send them their data."

Mission-critical successes

MidSTAR-1 has hosted a number of successful experiments that have provided significant breakthroughs in space technology. Naval Academy professor and MidSTAR-1 program manager Billy Smith says NASA is especially proud of the first-ever demonstration of applied nanotechnology in space as part of the Nano ChemSensor Unit (NCSU) project. Developed by scientists at NASA's Ames Research Center in California, NCSU operates like a smoke detector, sensing chemicals and contaminants that could be harmful to astronauts.

Another MidSTAR-1 experiment involved the successful demonstration of a special film, no thicker than a sandwich bag, that can help control the temperature of a spacecraft. Using the science of electrochromics, Eclipse Energy Systems, Inc. of Florida developed an experiment to prove via a voltage differential, that the radiant

properties of the film could be controlled, changing its ability to radiate waste heat into space or retain heat within a spacecraft.

Other experiments include the Configurable Fault Tolerant Processor (CFTP) developed by the Naval Postgraduate School to study the feasibility of using field-programmable gate arrays for spacecraft computer processing. MidSTAR-1 also carries the Internet Communications Satellite (ICSat) experiment, which is designed to test programmable radio transmitter and receiver modules for use in space.

Lessons learned

The MidSTAR-1 program has allowed Naval Academy students to gain first-hand experience in the planning, building and launching of a space satellite. Prof. Smith says, "One of our objectives was not so much to do things in space, but to have the students build something to a level of quality that would operate successfully in space. Getting the satellite launched and working properly in space validated the students' work as engineers, designers and construction technicians."

Langston adds another perspective: "Three years of Naval Academy students benefited from working in the design and concept phase, down to the subsystem design, and physically constructing, building, integrating and even purchasing the parts. These students are all Naval officers now."